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77

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MORTALITY OF HEMLOCK LOOPER LARVAE FOLLOWING SPRAYING WITH DDT

by

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SUMMARY

Satisfactory kill of the western hemlock looper infesting 14,810 acres of hemlock in western Washington was obtained by helicopter application of 3/4 pound of DDT per acre. Looper mortality was greatest in areas receiving the project rate of application as compared to areas sprayed lightly in order to minimize stream contamination. Checks after the spray project showed no increased defoliation in areas sprayed at the project rate, whereas some new defoliation was recorded in lightly sprayed areas. Heavy defoliation was noted in areas not sprayed with DDT.

INTRODUCTION

Following the report of insufficient hemlock looper (*Lambdina fiscellaria lugubrosa* Hulst) kill with the insecticide Sevin, Weyerhaeuser Company and Crown Zellerbach Corporation elected to spray 14,810 acres of heavily infested forest land with

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DDT[2/]. Of the total acreage sprayed, 8,715 acres belonged to Weyerhaeuser, 5,490 acres to Crown Zellerbach, and 605 acres to miscellaneous owners. The spray formulation used was 3/4 pound of DDT in 0.9375 quarts of solvent and enough #2 diesel oil to make 1-1/2 gallons. The spray was applied at the rate of 1-1/2 gallons per acre by helicopter.

In order to assess the results of the spraying on the looper, 33 plots each of 3 to 5 trees were established. The procedure used was essentially that outlined by Buffam (1963). Five 18-inch twigs were clipped from lower branches of each tree using a pole pruner (maximum height of 30 feet). The total number of loopers per 5-twig sample was recorded. Oil-sensitive spray cards were placed in openings of at least one-crown width at each plot. The number of cards per plot varied from 2 to 6. The spray cards were collected the day following spraying. Commencing 7 days after spraying, each plot was revisited and an additional 5 branches clipped. The number of live loopers was again recorded and the per cent kill computed. The stage of development of the loopers was somewhat beyond that recommended for best control (Buffam, 1963). On most plots, the larvae were in the 3rd or 4th instar, whereas on some plots many 5th instar larvae were present.

RESULTS

Descriptions of the sample plots are given in Table 1. The relative spray deposits shown in this table were obtained by arraying the 106 spray deposit cards in ten groups from no detectible spray to very heavy spray. Examples are shown in Figure 1. Davis' values were determined by visual comparison of each relative group with standards to give gallons per acre (Davis, 1954).

Figure 2 shows the relationship between the relative spray deposit and the per cent mortality of the hemlock looper. There was a highly significant correlation between the looper mortality and the dosage of DDT in relative units. The least-squares fit of the data was a curve of the shape $y = a+bX+cX^2$ where y is the per cent mortality in arc sin units, X is the dosage, X^2 the square of the dosage. To get actual mortality for any given dosage, the "y" value must be decoded by referring to a table of arc sin values. For the curve in Figure 2,

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2/ U. S. Forest Service biologists reported on July 19, 1963 that Sevin on a project basis was giving 17-70 per cent kill of loopers, whereas DDT averaged 95.7 per cent kill. On controlled tests, Sevin killed up to 86 per cent of loopers, whereas DDT killed 99 per cent.

Table 1. Plot location, insect counts (before and after spraying) and spray deposits -- 1963 hemlock looper spray project.

Location and description	Number insects before	Number insects after	Per cent mortality	Relative spray deposits	Davis' values 1/
Finn Creek	51*	32	38	1	0.01
Sec. 29,	50*	19	62	2	0.02
T 12N, R 9W	46*	39	15	1	0.01
Sec. 28,	56	11	80	5	0.10
T 12N, R 9W	103	54	48	2	0.02
	104	51	51	2	0.02
Sec. 27,	58*	6	90	6	0.30
T 12N, R 9W	90*	67	26	3	0.04
Seed Orchard	99	27	73	5	0.10
Sec. 28,	47	3	94	7	0.40
T 12N, R 9W	48	5	90	7	0.40
Middle Nemah	9*	4	56	3	0.04
Sec. 31,	115*	35	70	4	0.05
T 12N, R 9W	48*	7	86	6	0.30
Sec. 33,	33*	27	18	0	0.00
T 12N, R 9W	20*	16	20	0	0.00
	28*	19	32	0	0.00
Williams River	54	2	96	7	0.40
Sec. 17,	40	2	95	8	0.60
T 12N, R 9W	66	1	99	7	0.40
	110	0	100	9	0.70
Bear River	124*	0	100	7	0.40
Sec. 22,	62*	2	97	9	0.70
T 10N, R 10W	79*	14	79	6	0.30
	150*	0	100	8	0.60
	80*	3	97	7	0.40
	101	3	97	6	0.30
	156	8	95	7	0.40
	36	1	98	5	0.10
	97	18	82	4	0.05
	172	9	95	6	0.30
	38	1	98	5	0.10

1/ Gallons per acre values calculated by visual comparisons with Davis' standards.

*Trees with 3 trees per plot; all others had 5 trees per plot.

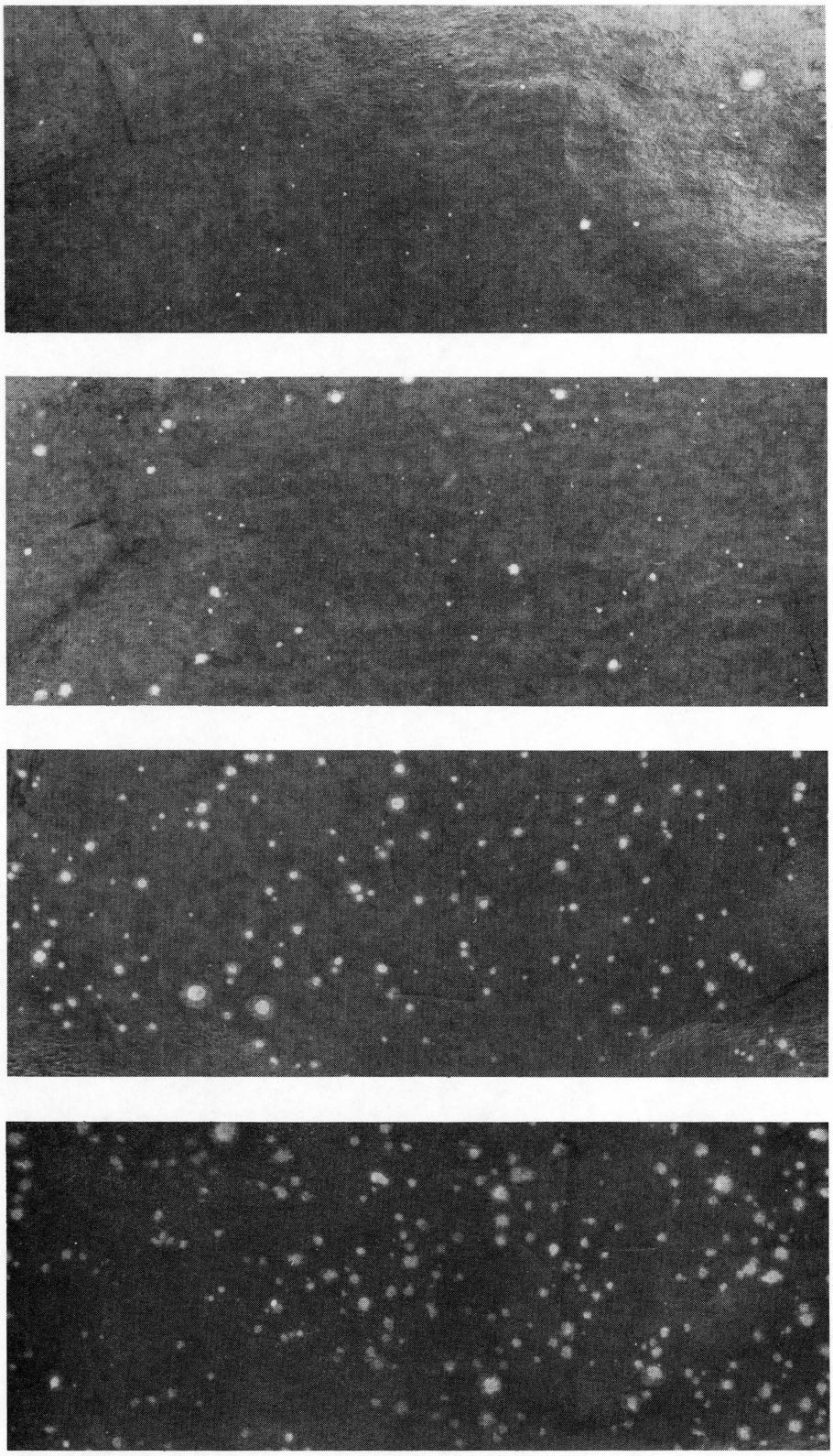

Fig. 1. Examples of spray deposits on oil-sensitive cards used to assess amounts of DDT used in control of the hemlock looper.

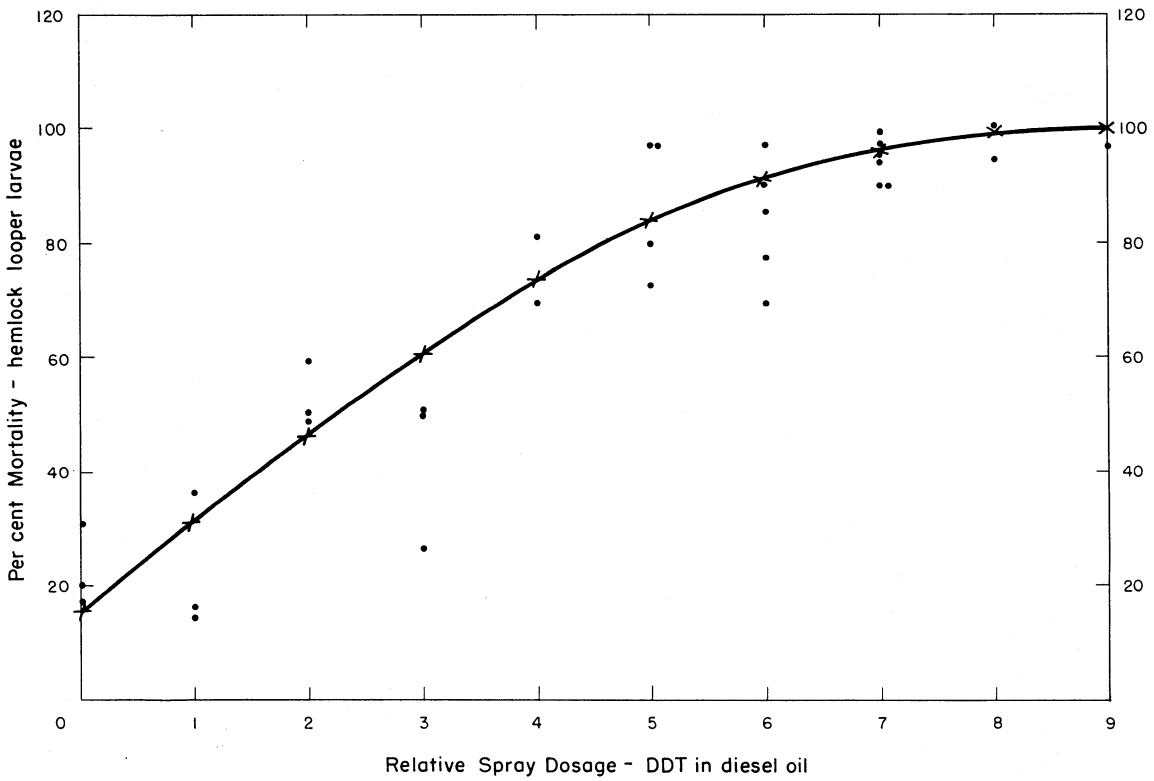

Fig. 2. Relationship between the relative spray dosage of DDT and per cent hemlock looper mortality.

"a" = (-0.364), "b" = 23.91, "c" = 10.37, and the standard error ±8.36. The correlation coefficient was 0.927.

On all plots in which the spray deposit reached a relative value of "7" or approximately 0.40 gallons per acre - as estimated from Davis' spray standards, the looper mortality was above 90 per cent. The two lowest values at relative deposit "6" are due in part to the sample trees being covered by overstory which prevented the spray from reaching them adequately.

Several traverses were made to distribute spray cards in order to get some measure of spray coverage on the project. Because of time limitations, the traverses were not located at random, but rather selected for specific reasons. For example, pilots had specific instructions to hold back from Finn Creek to prevent contamination of this important salmon stream and so this area was checked carefully. The relative deposits shown in Figures 3 and 4 indicate that for the most part little spray reached the stream, or the surrounding timber for that matter. The traverses in Sec. 17 and in upper Bear River were located in areas that were to be sprayed at the regular project rate. Both these areas received sufficient spray to control at least 95 per cent of the insects.

DISCUSSION

Though in this instance there was a significant correlation between looper mortality and relative deposit on oil-sensitive spray cards, other workers have not always found this to be true. For example, Maksymiuk (1963a) reports that after an analysis of data from three spray projects, he was unable to find a meaningful relationship between spruce budworm mortality and spray deposit on oil-sensitive spray cards. He attributes this failing to (1) the screening effect of the foliage such that spray reaching cards on the ground is not comparable to spray reaching the crowns, and (2) the lack of sensitivity of the cards to register the smaller drop sizes which are known to cause budworm mortality. The first factor can be rectified in part by placing the cards in openings of sufficient size to minimize overhead interference with the falling spray. Maksymiuk (1963b) showed that with spruce budworm spray (DDT in oil) only 49 per cent of the amount applied was recovered at distances less than the height of the nearest tree. Johnson (1963) showed that crowns on young, open-grown Douglas-fir collected a greater amount of the insecticide Guthion in the top, decreasing downward to the base of the tree where only 1/10 as much insecticide was found. Johnson did find a correlation between the spray deposits on spray-sensitive cards and actual amounts as determined by chemical analysis.

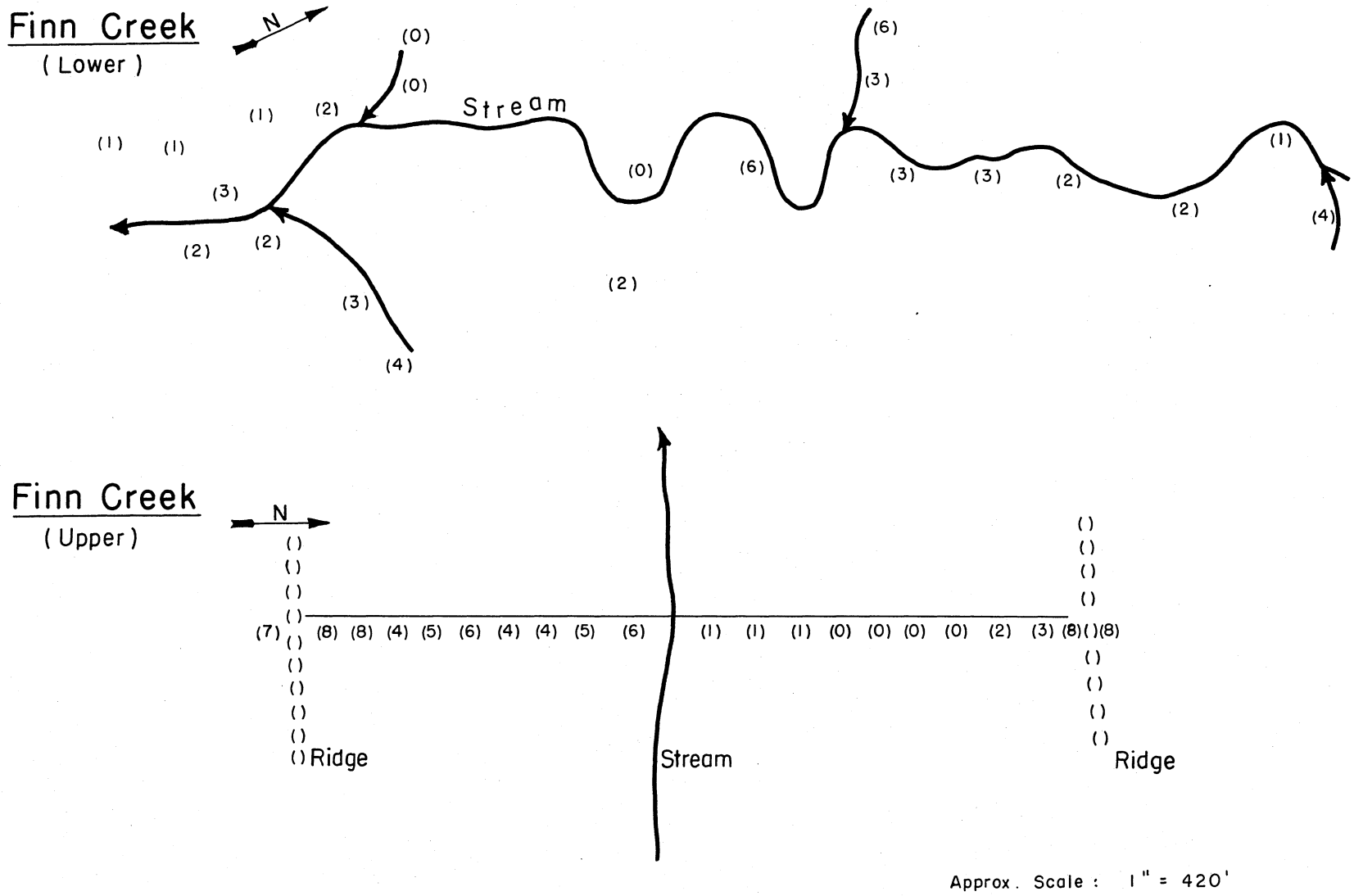

Fig. 3. Relative spray deposits (in parentheses) along Finn Creek -- an area that was sprayed lightly.

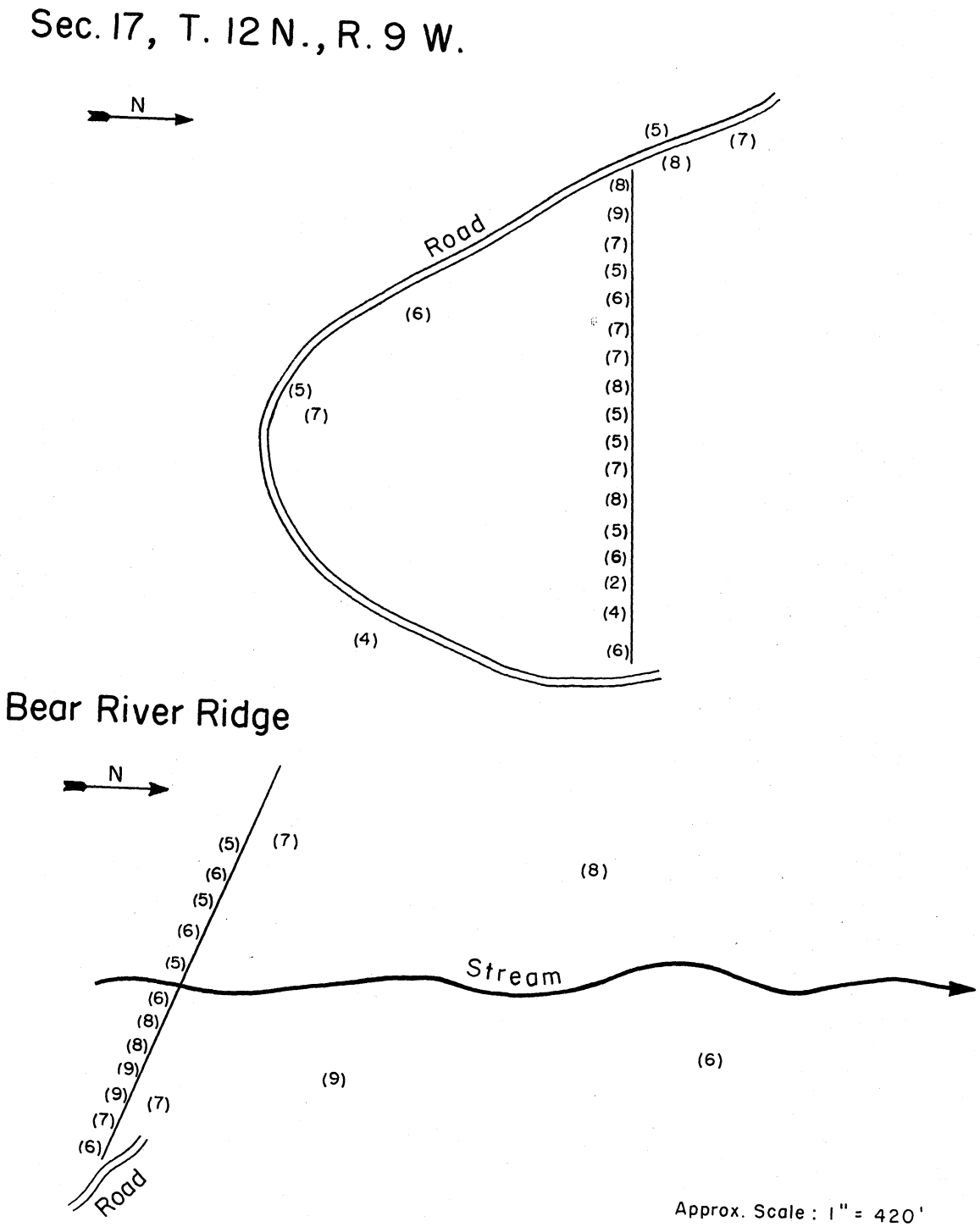

Fig. 4. Relative spray deposits in two areas sprayed at regular project rate.

In any event, the use of spray-sensitive cards on the forest floor can only give a rough indication of insecticide received in the crowns. Likewise, sampling of branches for hemlock loopers at heights of up to 30 feet is only a rough approximation of the number of loopers higher in the crown. However, it appears safe to assume that if control was achieved in the lower crown, a greater degree of control was achieved in the upper crown.

The distribution of spray cards was not sufficient to estimate the general spray coverage on the project. Reports from the monitoring helicopter indicate that most of the spray coverage was at least as good as that received at Bear River and Sec. 17[3/]. The overall gallonage applied divided by the number of acres sprayed was almost exactly 1.5 gallons, again indicating that the required coverage was achieved in most areas. The results of this report show that if the insecticide was applied at the contract rate, it was capable of killing the loopers.

An aerial reconnaissance of the spray area in September 1963 revealed some new defoliation along Finn Creek, an area sprayed only lightly, and a much greater amount on the northern part of Long Island and along Sun Point, areas that were not sprayed with DDT. There was no new defoliation detected in areas sprayed at the project rate with DDT. Thus, the project accomplished what it intended to do, namely to prevent defoliation in 1963 in areas of high timber value, poor accessibility and high looper populations.

3/ Personal communication with Mr. P. G. Lauterbach, Project Forester, Weyerhaeuser Company.

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